

- 1 1. A system for sorting multicellular organisms comprising:  
2 a population of multicellular organisms comprising a plurality of spatially  
3 distinct, optically detectable, phenotypic characteristics; and  
4 an instrument for detecting the location of the spatially distinct, optically  
5 detectable, phenotypic characteristic on the multicellular organism and for orienting the  
6 worm along its longitudinal axis.  
7
- 8 2. The system of claim 1, wherein the spatially distinct, optically detectable,  
9 phenotypic characteristics comprise a marker pattern comprising a plurality of spatially  
10 consistent first features spaced apart along a length of each organism and at least one  
11 second feature modifiable or inducible when the population is subjected to a test  
12 treatment.  
13
- 14 3. The system of claim 1, wherein the instrument is a flow cytometer equipped to  
15 process elongate multicellular organisms.  
16
- 17 4. The method of claim 1, wherein the instrument measures a gating signal for  
18 detecting the spatially distinct, optically detectable, phenotypic characteristic over  
19 background signals.  
20
- 21 5. The system of claim 4, wherein the gating signal gating signal comprises light  
22 scattered in the forward direction.  
23
- 24 6. The process of claim 4, wherein the gating signal comprises light attenuated by  
25 the organism in the forward direction.  
26
- 27 7. The system of claim 1, wherein the instrument further comprises:  
28 a source containing multicellular organisms in a fluid suspension;

1 means for causing the fluid suspension to move in a direction of flow;  
2 means for aligning the elongate multicellular organisms relative to the direction of  
3 flow;  
4 a light source for producing an optical beam through which the elongate  
5 multicellular organisms pass after becoming aligned;  
6 a first optical detector for detecting light over a solid angle of at least 20 degrees  
7 and over a collection angle of approximately 0.0 to 6.0 degrees in the horizontal axis and  
8 approximately 17 degrees in the vertical axis, for detecting passage of said organisms  
9 through said optical beam; and  
10 a fluid switch downstream of a point where said organisms pass through said  
11 optical beam, said switch responsive to the first optical detector to allow detected objects  
12 to pass to a sample container.

13  
14 8. The system of claim 7, further comprising additional optical detectors for  
15 detecting sequential optical characteristics arrayed along a length of the multicellular  
16 organism wherein outputs of said detectors are gated by an output of the first optical  
17 detector to produce gated outputs.

18  
19 9. The system of claim 8, further comprising a data representation of the sequential  
20 optical characteristics comprised of the outputs of the additional optical detectors.

21  
22 10. The system of claim 9, further comprising a controller connected to the fluid  
23 switch and operative to cause said switch to select multicellular organisms showing data  
24 representations meeting predetermined criteria.

25  
26 11. A method for sorting multicellular organisms comprising the steps of:  
27 providing a population of test organisms, wherein each member of the population  
28 displays at least one spatially distinct, optically detectable, phenotypic characteristic;

1 analyzing the arrangement of spatially distinct, optically detectable, phenotypic  
2 characteristics of each population member; and

3 depositing members of the population based on the arrangement of spatially  
4 distinct, optically detectable, phenotypic characteristics.

5  
6 12. The method of claim 11, wherein the spatially distinct, optically detectable,  
7 phenotypic characteristics comprise a marker pattern comprising a plurality of spatially  
8 consistent first features spaced apart along a length of each organism and at least one  
9 second feature modifiable or inducible when the population is subjected to a test  
10 treatment.

11  
12 13. The method of claim 12, wherein the organisms are selected based on the  
13 location of the second feature with respect to the first features along the length of each  
14 organism.

15  
16 14. The method of claim 12, wherein the organisms are deposited based on the  
17 location of the second feature with respect to the first features along the length of each  
18 organism.

19  
20 15. An instrument for analyzing and selectively dispensing elongate multicellular  
21 organisms comprising:

22 a source containing multicellular organisms in a fluid suspension;

23 means for causing the fluid suspension to move in a direction of flow;

24 means for aligning the elongate multicellular organisms relative to the direction of  
25 flow;

26 a light source for producing an optical beam through which the elongate  
27 multicellular organisms pass after becoming aligned;

1 a first optical detector for detecting light over a solid angle of at least 20 degrees  
2 and over a collection angle of approximately 0.0 to 6.0 degrees in the horizontal axis and  
3 approximately 17 degrees in the vertical axis for detecting passage of said organisms  
4 through said optical beam; and

5 a fluid switch downstream of a point where said organisms pass through said  
6 optical beam, said switch responsive to the first optical detector to allow detected objects  
7 to pass to a sample container.  
8

9 16. The instrument of claim 15, further comprising additional optical detectors for  
10 detecting sequential optical characteristics arrayed along a length of the multicellular  
11 organism wherein outputs of said detectors are gated by an output of the first optical  
12 detector to produce gated outputs.  
13

14 17. The instrument of claim 16, further comprising a data representation of the  
15 sequential optical characteristics comprised of the outputs of the additional optical  
16 detectors.  
17

18 18. The instrument of claim 17, further comprising a controller connected to the fluid  
19 switch and operative to cause said switch to select multicellular organisms showing data  
20 representations meeting predetermined criteria.  
21

22 19. A method of selectively dispensing elongate multicellular organisms comprising  
23 the steps of:

24 centering and orienting the sample objects in a flowing fluid stream;  
25 passing the fluid stream through a sensing zone;  
26 optically detecting the presence of a multicellular organism passing through the  
27 sensing zone by means of a light scatter sensor that has an acceptance angle of at least 20

1 degrees and over a collection angle of approximately 0.0 to 6.0 degrees in the horizontal  
2 axis and approximately 17 degrees in the vertical axis;

3 creating a data representation of sequential optical characteristics of the  
4 multicellular organism comprising output signals from additional optical sensors;

5 diverting at least some portion of the fluid stream with a switched fluid stream  
6 based on the data representation so as to collect ones of the multicellular organisms  
7 remaining in portions of the sample stream that were not diverted.

8  
9 20. The method of claim 19, further comprising the step of exposing the multicellular  
10 organisms collected in the step of diverting to a test chemical or test environment.

11  
12 21. The method of claim 19 further comprising the step of exposing the multicellular  
13 organisms to a test chemical or a test environment prior to the detecting step to determine  
14 whether the data representation is altered by the test chemical or the test environment.

15  
16 22. A data structure representative of an oriented elongate multicellular organism  
17 containing indicia of sequential optical characteristics disposed along a length of said  
18 organism, said data structure comprised of stored sequential outputs derived from optical  
19 sensors arranged to receive optical energy emanating from the elongate multicellular  
20 organism as said organism passes through an optical beam wherein a signal from a light  
21 scatter sensor that has an acceptance angle of at least 20 degrees and over a collection  
22 angle of approximately 0.0 to 6.0 degrees in the horizontal axis and approximately 17  
23 degrees in the vertical axis is used to create or utilize the data structure.

24  
25 23. A process for analyzing elongate multicellular organisms by flow cytometry  
26 comprising the steps of:

27 creating a population of test organisms wherein each member of the population  
28 displays a marker pattern, said marker pattern representing a plurality of spatially

1 consistent first features spaced apart along a length of each organism and wherein each  
2 member of the population also displays at least one of a second feature modifiable or  
3 inducible when the population is subjected to a test treatment, each of said first and said  
4 second features being detectable through analysis with a flow cytometer;  
5       subjecting the population to a test treatment;  
6       analyzing members of the population with a flow cytometer equipped to process  
7 elongate multicellular organisms; detecting the marker pattern on the members analyzed;  
8 and  
9       using the detected marker pattern to determine status of the second feature on  
10 each of the members analyzed.

11  
12 24. The process according to claim 23, wherein the step of creating a population  
13 includes the step of producing a transgenic organism.

14  
15 25. The process according to claim 24, wherein the step of producing a transgenic  
16 organism includes choice of a particular promoter.

17  
18 26. The process according to claim 23, wherein the marker pattern is detectable by a  
19 flow cytometer by use of detection means selected from the group consisting of light  
20 scatter, light absorption and fluorescence.

21  
22 27. The process according to claim 23, wherein the step of subjecting the population  
23 to a test treatment includes contacting the population with a candidate drug molecule.

24  
25 28. The process according to claim 23, wherein the second feature responds to the test  
26 treatment by a change detected as an optical signal, the change being one selected from

1 the group consisting of an increased signal, a decreased signal or a positionally altered  
2 signal.

3

4 29. The process according to claim 23, wherein the step of using the detected marker  
5 pattern includes the step of determining a longitudinal orientation of each member of the  
6 population analyzed.

7

8 30. The process according to claim 23, wherein the step of using the detected marker  
9 pattern includes the step of limiting analysis of data corresponding to the second feature  
10 to a particular longitudinal region of each of the members analyzed.

11

12 31. The process according to claim 23, wherein the step of using the detected marker  
13 pattern includes the step of altering a mode data analysis for data corresponding to the  
14 second feature in a particular longitudinal region of each of the members analyzed.

15

16 32. The process according to claim 31, wherein the mode of data analysis is selected  
17 from the group consisting of signal peak analysis and signal integration.

18

19 33. The process of claim 23, wherein the step of analyzing members of the population  
20 with a flow cytometer comprises selecting a gating signal.

21

22 34. The process of claim 33, wherein the gating signal comprises light scattered in the  
23 forward direction.

24

1 35. The process of claim 33, wherein the gating signal comprises light attenuated by  
2 the organism in the forward direction.

3  
4 36. A process for preparing a model strain of elongate multicellular organisms  
5 intended for specialized flow cytometry analysis comprising the steps of:

6 creating a marker strain of organisms wherein each member of the strain  
7 displays a marker pattern, said marker pattern representing a  
8 plurality of marker features spaced apart along a length of each  
9 organism and spatially consistent from member to member, said  
10 marker features being detectable through analysis with a flow  
11 cytometer;

12 creating a test strain of organisms wherein each organism of the test strain  
13 displays at least one test feature modifiable or inducible when the  
14 test strain is subjected to a test treatment, said test features being  
15 detectable through analysis with a flow cytometer; and

16 creating a model strain by combining the marker pattern from the marker  
17 strain with the test features from the test strain so that each  
18 organism of the model strain displays both the marker pattern and  
19 at least one test feature.

20  
21 37. An organism belonging to a model strain produced by the process of claim 36.  
22

23 38. A process for analyzing elongate multicellular organisms by flow cytometry  
24 comprising the steps of:

25 subjecting a population of the model strain of claim 36 to a test treatment;  
26 analyzing members of the subjected population with a flow cytometer  
27 equipped to process elongate multicellular organisms;



1 detecting the marker pattern on the members analyzed; and  
2 using the detected marker pattern to determine status of the test feature on  
3 each of the members analyzed.  
4

5 39. The process according to claim 36, wherein the step of creating a population  
6 includes the step of producing a transgenic organism.  
7

8 40. The process according to claim 36, wherein the step of producing a transgenic  
9 organism includes choice of a particular promoter.  
10

11 41. The process according to claim 38, wherein the marker pattern is detectable by a  
12 flow cytometer by use of detection means selected from the group consisting of light  
13 scatter, light absorption and fluorescence.  
14

15 42. The process according to claim 38, wherein the step of subjecting the population  
16 to a test treatment includes contacting the population with a candidate drug molecule.  
17

18 43. The process according to claim 38, wherein the test feature responds to the test  
19 treatment by a change detected as an optical signal, the change being one selected from  
20 the group consisting of an increased signal, a decreased signal or a positionally altered  
21 signal.  
22

23 44. The process according to claim 38, wherein the step of using the detected marker  
24 pattern includes the step of determining a longitudinal orientation of each member of the

1 population analyzed.

2

3 45. The process according to claim 38, wherein the step of using the detected marker  
4 pattern includes the step of limiting analysis of data corresponding to the second feature  
5 to a particular longitudinal region of each of the members analyzed.

6

7 46. The process according to claim 38, wherein the step of using the detected marker  
8 pattern includes the step of altering a mode data analysis for data corresponding to the  
9 second feature in a particular longitudinal region of each of the members analyzed.

10

11 47. The process according to claim 46, wherein the mode of data analysis is selected  
12 from the group consisting of signal peak analysis and signal integration.

13